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THE USE OF VIDEO RECORDINGS IN TEACHER EDUCATION.

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DESCRIPTORS- *VIDEO TAPE RECORDINGS, *OBSERVATION, *PERFORMANCE, *STUDENT TEACHERS, *SUPERVISION, TEACHER EDUCATION, FEEDBACK, STANFORD

THE PURPOSE OF THE STUDY WAS TO DETEMINE IF THE QUALITY AND LOGISTICS OF SUPERVISION IN TEACHER TRAINING PROGRAMS COULD BE IMPROVED BY SUBSTITUTING VIDEO RECORDINGS FOR LIVE CLASSROOM OBSERVATIONS. RESULTS SHOWED THAT (1) TEACHER TRAINEES WHO RECEIVE FEEDBACK ON THEIR TEACHING PERFORMANCE MAKE GREATER CHANGES IN SELECTED BEHAVIORS THAN TRAINEES WHO DO NOT RECEIVE FEEDBACK AND (2) VIDEO PLUS VERBAL FEEDBACK PRODUCES GREATER CHANGES IN SELECTED BEHAVIORS THAN VERBAL FEEDBACK ALONE. THE RESULTS DID NOT PROVE CONCLUSIVELY THAT VIDEO RECORDINGS COULD ALWAYS BE SUBSTITUTED FOR LIVE OBSERVATIONS IN TEACHER EDUCATION. THE AUTHOR CONCLUDED THAT (1) BY ELIMINATING THE TRANSPORTATION TIME PROBLEM, VIDEO RECORDINGS CAN OFTEN HELP THE SUPERVISOR TO BETTER PERFORM THE TASK FOR WHICH HE IS TRAINED, AND (2) VIDEO RECORDINGS OFFER THE POSSIBILITY OF INCREASING THE LOAD THAT UNIVERSITY TEACHER-TRAINING SUPERVISORS CAN ASSUME. (AL)

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(5-208)

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by

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Small Grants Report

June 14, 1965

PURPOSE OF THE STUDY

The purpose of the study was to determine if the quality and logistics of supervision in teacher training programs could be improved by substituting video recordings for live classroom observations.

For the purpose of the research "improved quality of supervision" was defined as the change of selected trainee behaviors as measured by the Stanford Micro-Teaching Appraisal Guide. (See Appendix). Although the ultimate success of teacher education must be measured in terms of pupil learning, a valid intermediate objective of teacher education is to get teachers to exhibit certain prescribed behaviors when they teach (Medley and Mitzel, 1963). This research focused clearly on the intermediate objectives of teacher education.

BACKGROUND OF THE PROBLEM

Historically, the functional role of the supervisory teacher in this country was recognized at the beginning of the nineteenth century when the first normal schools were being established (Troisi, 1959). Many administrators (Strebel, 1953; Chase, et al, 1936; Troisi, 1959; Woodring and Scanlon, 1963; Conant, 1963), as well as trainees (Townsend, 1935; Cress, 1941; Troisi, 1959) consider supervision as a useful, if not an essential element in the total training system. As a rule, however, supervisors have not applied rigorous methods of measurement to the products of supervision (Barr, et al, 1949; Troisi, 1959). Assuming that supervision is an important part of teacher training programs, a variety of research is needed to discover and to validate procedures superior to those currently endorsed (Douglass and

Boardman, 1954). The availability of the portable video tape-recorder may enable educators to investigate previously unanswered questions related to the effectiveness of supervisors and, perhaps, to develop supervision programs which have increased educational effectiveness.

The responsibility for supervision of Interns in the Stanford Secondary Education Program is assumed by cooperating schools' supervisors and Stanford supervisors (graduate assistants). Typically, supervisors observe teachers' classes and then hold individual conferences with the teachers. Although supervisors perform other tasks (Waddell, 1953; Rumin and Curtis, 1959). Evidence supports the claim (Burton, 1955; Alberty and Thayer, 1931; Hammock and Owings, 1955; Abbott, 1957) that the feedback given by supervisors to teachers at follow-up conferences is the most single task performed by supervisors. Schramm (1963) defines "feedback" as the information one receives that tells him how well he is doing.

The teacher-supervisor conference is a communicative act in which information (feedback) is transmitted from an information source (supervisor) to a human recipient (teacher) (McDonald, 1961). Laswell (1949) and Hovland (1963) have developed a paradigm by which a communicative act can be analyzed. The communicative process can be analyzed from any of five points of reference, namely: (1) Who, (2) says what, (3) in which channel, (4) to whom, (5) with what effect (Laswell, 1949)?

Using the paradigm, then, the teacher-supervisor conference becomes:

(1) Who--supervisor

(2) says what--professional instruction

(3) in which channel--verbal or verbal and video recordings

(4) to whom--trainees

(5) with what effects?--changes in selected teacher behaviors.

By altering various elements in the paradigm the effects of the communicative act can be changed. For example, investigators using audio-visual equipment to provide reinforcement, feedback, and knowledge have shown that audio-visual feedback is superior to audio feedback alone. (Kimble and Wulff, 1953; Hartmann, 1961; Hirsch, 1961; Michael and Maccoby, 1953, 1961; Lumsdaine, 1949). Lumsdaine (1961) made the cogent observation that "hearing," "seeing," and "perceiving" as generally understood involve some form of perceptual response which ordinarily furnishes a source of stimulation. Although the use of video recordings to improve supervision is still in the exploratory stage, Aubertine (1963) in a preliminary study at Stanford found that teachers who were given video feedback and an opportunity for practice to correct their mistakes performed significantly better ($p<.01$) on subsequent demonstrations than a control group which was given neither an opportunity to practice nor video feedback. Another group of trainees given verbal feedback and an opportunity to practice also performed significantly better ($p<.05$) on subsequent demonstrations than the previously mentioned control group. Further, the investigator found that the group which received the video feedback improved more ($p<.05$) than a third group which had an opportunity to practice but received no feedback.

If video recordings provide feedback which can help supervisors change teacher behaviors, the role of the supervisor may change considerably.

Supervisors are expected to make two observations per month and are given released time for this purpose. Many of the supervisors, however, have heavy teaching and study loads and use the released time for purposes other than supervision. Supervisors are frequently too busy with other responsibilities to provide appropriate supervision. When the supervisor does make field observations, a tremendous expenditure of non-productive time must be spent traveling to and from the cooperating schools. Video recordings can be used to "bring the classroom to the University." The important question, then, is: can video recordings be an effective source of information for supervisory conferences?

Hammock and Owings (1955) suggest that supervisors must understand the psychology of learning and the methods for guiding learning. Stanford University supervisors who have had advanced clinical training, assuming that the training were effective, should be able to provide neophyte teachers with more effective assistance than supervisores who have had only minimum supervisory training. The supervisor must understand with thoroughness the ways in which people learn. In addition to clinical training, Stanford University supervisors have the experiences gained in their doctoral studies to draw upon when they propose alternatives for improvement of instruction to trainees.

The only sound approach to supervision of practice teaching is one based on a complete integration of theory and practice (Armstrong, 1939). By this approach the supervisor is not only a guide in

the application of theory, he becomes the actual teacher of theory. Theory and practice go hand-in-hand; at one time theory grows out of practice, at another, practice is motivated and guided by theory. The supervisor, perhaps because of his doctoral studies and because he has associations with both the University and the cooperating schools, may be in a better position than the school supervisor to translate the relationship between the activities required by the University and the practical application of theory in the classroom.

Video recordings may enable teacher training programs to substitute video recordings for live observations and, consequently, to improve the quality of supervisory programs.

HYPOTHESES

The specific hypotheses tested follow:

1. Teachers who receive feedback from supervisors will register more desired change in behavior than teachers who make only self-analyses.

2. Teachers who receive feedback from supervisors who have observed prerecorded video tapes will register more desired change in behavior than teachers who receive feedback from supervisors who have made live observations. (See figure A.)

3. Teachers who receive verbal and video tape feedback from supervisors will register more desired change in behavior than teachers who receive only verbal feedback from supervisors. (See figure B.)

Sub-hypotheses a. through c., listed below, predict in order of effectiveness the differences among all of the groups. These hypotheses are consistent with the major hypotheses described above. (Figure C illustrates the sub-hypotheses which have been derived from the two major hypotheses---numbers 2 and 3 above). Specifically, the sub-hypotheses tested were:

a. Teachers who receive verbal and video tape feedback from supervisors who have observed prerecorded video tapes will register more desired change in behavior than teachers who receive verbal and video feedback from supervisors who have made live observations. (Boxes 1 vs. 2--Figure C.)

b. Teachers who receive verbal and video tape feedback from supervisors who have made live observations will register more desired change in behavior than teachers who receive only verbal feedback from supervisors who have observed prerecorded video tapes. (Boxes 2 vs. 3--Figure C.)

c. Teachers who receive verbal feedback from supervisors who have observed prerecorded video tapes will register more desired change in behavior than teachers who receive verbal feedback from supervisors who have observed live observations. (Boxes 3 vs. 4--Figure D.)

Figure A
Prerecorded tape observations vs. Live observations

Figure B
Video tape plus verbal feedback vs. Verbal feedback only

Figure C

	Verbal Feedback Only		Verbal plus Video Feedback	
	LIVE	PRERECORDED	LIVE	PRERECORDED
SUPERVISORS	4	3 (c)	2 (b)	1 (a)
CONTROL GROUP				

PROCEDURE

A random sample of 75-120 persons from a group of approximately 120 Interns in the Secondary Education Program at Stanford University were selected to participate in the research project. The trainees selected were divided into five groups, fifteen to thirty trainees in each group.

Each of the trainees prepared a five minute lesson on any topic in his major teaching area; he presented his lesson to a group of five high school students who were asked to come to the University on the days the Micro-teaching demonstrations were held.

Video tape recordings were made of all presentations. Following the presentations, the students evaluated the performance* indicating the teacher's effectiveness on the designated criteria.

The composition of the groups is illustrated in the chart below. (The number of each discrete group corresponds to the respective box in Figure C.)

GROUP	COMPOSITION (Trainees)
1	15-30
2	15-30
3	15-30
4	15-30
5	15-30

*The evaluation instrument, Stanford Micro-Teaching Appraisal Guide, had been pre-tested and used in other research. (See Appendix.)

The supervisors used in the project were the same individuals who are regularly responsible for the trainees in the Secondary Education Program.

Supervisors were given ten minutes to critique the lesson with the trainee. Following the critique, the trainee were given thirty minutes to reflect upon the points made at the post-teaching critique and an opportunity to reorganize the same lesson for a five minute presentation to an alternate group of five high school students. An evaluation by students and a critique by supervisors followed the second presentation. (At no time were the supervisors given information indicating the students' ratings of teacher effectiveness--this paralleled the actual classroom condition. All supervisors, however, were cognizant of the specific criteria used by students for evaluating teacher effectiveness.) After a one week time lapse the teachers presented a second lesson under the same conditions. The total experimental test, therefore, involved four practice-teaching opportunities to augment the expected differences. The Micro-teaching format follows:

1st Week	5 minute lesson--10 minute critique
(Lesson No. 1)	30 minute reflection and preparation period
	5 minute lesson--10 minute critique
2nd Week	5 minute lesson--10 minute critique
(Lesson No. 2)	30 minute reflection and preparation period
	5 minute lesson--10 minute critique

Trainees participating in the investigation were asked to refrain from discussing any parts of the experiment with each other until all relevant data had been gathered. Analyses and interpretations were made at the conslusion of the project for all interested participants. A time period of twelve weeks was necessary to complete the Micro-teaching sessions.

CRITERIA

Medley and Mitzel (1963) summarized many of the studies which had been concerned with the measurement of classroom behavior by systematic observation. They concluded by stating that the process of selecting the behaviors to be recorded is essentially one of identifying a limited range of behaviors relevant to the purpose of the study and of constructing categories or items to be used by the observer. Studies at Stanford University in Micro-teaching (Aubertine, 1963) used the following criteria against which the effectiveness of the teacher was measured:

A. Aims
   1. Development
   2. Understanding
B. Content
   1. Organization
   2. Meaning
C. Method--teacher-pupil communication
D. Evaluation
   1. Review
   2. Reinforcement

The criteria outlined in the previous paragraph are relevant to the teaching act. The criteria selected by Aubertine and by this investigator match closely those used in the Stanford Appraisal Guides for Teaching Effectiveness (Garrison, 1963).

High school students were used by the Secondary Education Project to rate teacher effectiveness. Inter- and intra-rater reliability between students and between student groups, respectively, using the prescribed criteria, has been established at $p < .05$ level of significance. In addition, the students' ratings of teachers in Micro-teaching and the same teachers' performances in the classroom correlated at $p < .001$ level of significance ($r = .64$). Other investigators

(French, 1957; Hodgson, 1958; Remmers, 1934, 1960) found that students' ratings provided consistent and reliable data.

The evaluation scale enabled the investigator to quantify each criterion as well as global ratings. The lower the point score on each criterion and on all criteria, the better the relative effectiveness of the teacher. Desired behavior change, then, was determined by the relative lowering of specific and global point totals.

STATISTICAL PROCESS

Statistical analyses included comparisons of the effects of various types of feedback on each of the eight criteria items within the Stanford Micro-Teaching Appraisal Guide. The analyses included comparisons of changes of trainees' behaviors between an initial and a subsequent teaching trial, i.e. teaching Trial 1 vs. teaching Trial 4.

Probability <.05 was chosen as the significance level for rejecting the null hypothesis. Identification of each group as the groups are listed in the Tables is indicated in Illustrations A, B, and C (see page 7).

For all criteria the results of the comparisons indicated that the trainees who received feedback improved significantly more (p .05) than the no-feedback group.

Additional analyses were made to determine the relationship between specific groups of trainees who received different types of feedback from supervisors who employed different observation conditions and different types of feedback with F (4.95)>2.02, p <.10; with F (4.95) >2.50, p <.05; and with F (4.95) >3.57, p<.01; the following results were found:

For Item 1, among the groups which received feedback, there was no significant change in behavior between any groups.

For Item 2, among the groups which received feedback, there was no significant change in behavior between any groups.

For Item 5, among the groups which received feedback, there was no significant change in beharior between any groups.

For Item 6, among the groups which received feedback, there was no significant change in behavior between any groups.

For Item 7, among the groups which received feedback, there was no significant change in beharior between any groups.

Significant differences, however, were found for items 3,4, and 8 when specific groups were analyzed. For example, $p < .05$ for item 3 between groups 1 and 4 and between groups 1 and 2, but not between groups 3 and 4 (see appendices II, IV, and III, respectively). Also, $p < .05$ for item 4 between groups 1 and 2, but not between groups 1 and 4 and between groups 3 and 4 (see appendices VII, V, and VI, respectively). Significant differences $p < .05$ were found between groups 1 and 4, and between groups 1 and 2, but not between groups 3 and 4 (see appendices VIII, X, and IX, respectively).

By analyzing total scores for all criteria, significant differences $p < .05$ between groups 1 and 2, between groups 1 and 4, and between groups 3 and 4 (see appendices XI, XII, and XIII, respectively).

CHANGES OF BEHAVIOR

The analyses indicated that some behaviors were more susceptible to change than others. The criterion measures identified as Items 3, 4, and 8 appeared to be more susceptible to change than the other behaviors.

RESULTS AND IMPLICATIONS

Can video recordings be substituted for live observations in teacher education? Several questions were asked to determine the answer for the question stated above. The specific questions were:

1. Do trainees need feedback if they are to change their teaching behaviors?

2. If the supervisor is able to "show" the trainee as well as "tell" the trainee what needs to be done to improve the teaching performance, will the trainee make greater improvement in the teaching performance than the trainee who receives verbal feedback only from a supervisor?

3. Can enough information be obtained from video recordings to permit effective supervisory conferences?

"Yes" seemed to be the qualified answer for all questions. The qualifications are outlined in the report below. The report refers to the specific testing of each hypothesis.

Hypothesis 1--Teachers who receive feedback from supervisors will register more desired change in behavior than teachers who make only self-analyses.

Result: For all groups, teachers who received feedback from supervisors recorded significantly improved behavior $p < .05$ than teachers who made self-analyses.

Hypothesis 2--Teachers who received feedback from supervisors who have observed prerecorded video taps will register more desired change in behavior than teachers who receive feedback from supervisors who have made live observations.

Result: By comparing groups 1 and 2 with groups 3 and 4, no significant change in teacher performance was noted.

Hypothesis 3--Teachers who receive verbal and video tape feedback from supervisors will register more desired change in behavior than teacher who receive only verbal feedback from supervisors.

Result: Teachers who received verbal and video tape feedback from supervisors did register more significant improvement in behavior $p < .05$ than teachers who received only verbal feedback from supervisors on specific criterion measures, e.g., Items 3, 4, and 8--organization and meaning of content, and total reaction to the lesson, respectively.

FUTURE RESEARCH NEEDED

Several hypotheses for future research were generated from the results of the study. On future study, for example, should attempt to determine the appropriate amount of time a trainee should teach during micro-teaching sessions in order to produce maximum desired change in behavior. The micro-teaching laboratory sessions in this study lasted for a duration of five minutes. This may or may not be enough time for the supervisor to appraise the selected behaviors performed by trainees.

Another variable that needs to be studied is the effect of various types of feedback on trainees at different phases of their teaching maturity, i.e., early in the trainees' learning experiences or after the trainee has had considerable classroom experience. It is possible that certain types of feedback are more appropriate for "beginning" trainees and other types of feedback might be more appropriate for "veteran" trainees.

Clearly, some types of behaviors seem to be more susceptible to change than other types of behaviors. Additional investigations should be made to determine if there is a definite, direct relationship between specific types of feedback and specific kinds of behaviors.

Some feedback treatments might be more powerful with individuals who have certain specific personality characteristics. An investigation which attempts to match the feedback treatment with the trainees' personalities should produce valuable information for individuals interested in the supervisory phase of teacher education programs.

As the described study progressed, other uses of the video tapes

and different types of feedback were recognized. Future studies, perhaps, should investigate the following questions:

1. Can trainees who observe their own video tapes change as much or more than trainees who receive feedback from supervisors?

2. Can trainees observe other trainees' video tapes and transfer whatever perceptions they make about the teaching performance to their own teaching performances?

CONCLUSION

The evidence gained in this research demonstrates that one feedback treatment is more powerful than other feedback treatments for selected behaviors. The evidence indicates that some behaviors are more susceptible to change than others and that the interaction effects of some variables are more powerful than the interaction effects of other variables. Moreover, it should be noted that specific feedback treatments do not have the same influence on all behaviors. For specific behaviors one type of treatment may be more effective than others. The selection of the most powerful treatment, therefore, may depend upon the specific behavior to be changed.

Briefly stated, the results of the investigation indicated that:

1. Trainees who receive feedback make greater changes on selected behaviors than trainees who do not receive feedback.

2. Some behaviors are more susceptible to immediate change as a result of the nature of the feedback treatment than other behaviors.

3. Video plus verbal feedback produces greater changes in selected behaviors than verbal feedback alone.

The results do not provide conclusive evidence that video recordings can be substituted for live observations in teacher education. The study does suggest the need for additional study to more care-

fully analyze the effects of specific feedback treatments and to explore other possible uses of video recordings for supervision of trainees in teacher education programs.

If additional investigation suggests that more powerful feedback treatments can be provided when video recordings are substituted for live observations, some of the implied administrative advantages of video recordings can be put to good use. Specific administrative implications for the substitution of video recordings for live observations are noted below.

Because supervisors are frequently pressed for time, by substituting prerecorded observations for live observations, the need for the supervisor to be in the classroom when the lesson is taught is reduced. For the school supervisors who have difficulty coordinating their schedules with the trainee's schedule, it is possible to video tape the teaching performance and to play the tape back when both the trainee and the supervisor have the opportunity to view it. For the university supervisors who consume valuable time driving to and from the trainee's school, it is possible to video tape the teaching performance and to play the tape back when the trainee returns to the campus for his academic classes.

If there were two or more trainees teaching at a given school and two or more university supervisors were assigned to the trainees, it would be possible to assign technicians to the task of video taping for the classes, eliminating the duplication of supervisory efforts. The playback would occur at the university. Certainly, utilization of supervisors' time should be considered in teacher education programs.

In some teacher education programs the senior professor seldom, if ever, has the opportunity to observe the trainees in the classroom. It would seem reasonable that the professor would be more apt to observe a prerecorded video tape than he would to take the time necessary for travel to and from a given school. From the opportunity to observe the progress his trainees make in the classroom, the professor may be able to adjust the content of his course to meet more specifically the needs of his trainees. The perceived gap between educational theory and educational practice may be reduced.

If supervisors could centralize the location of their feedback conference at the university rather than at the various schools where the trainees are assigned, more frequent conferences could be held. Video recordings of the trainees' teaching performances could encourage this possibility.

Some teacher education programs suffer from the problem of too many trainees for too few supervisors. Video recordings offer the possibility of increasing the load that university supervisors can assume. By utilizing more efficiently the time of the supervisors, especially eliminating the transportation problem, video recordings can be used to help the supervisor perform the task for which he is trained.

Administrators who are responsible for teacher training programs must determine the rewards which will be gained from the use of video recordings. The potential rewards are determined by considering the various effects of feedback treatments and by evaluating the

human and financial costs necessary to make such a program operative. When the rewards are greater than the costs, video recordings can, and should, replace live observations in teacher education.

Appendix I

Name of Teacher _____ Date _____

PUPIL EVALUATION OF TEACHING - APPRAISAL FORM

App. Scale	1 Superior	2 Good	3 Fair	4 Below Average	5 Incomplete
AIMS: Behav. Change Desired	Fully developed and clearly understood	Developed and generally understood	Some developed and partly understood	Incompletely developed with little understanding	No apparent aims development evident
1. Development					
2. Understand.					
CONTENT:	Well organized and meaningful throughout	Good organiz. with most of content meaningful	Fair organiz. some content not meaningful	Weak organiz. little meaning in content	Very weak organization, Meaning content lacking
1. Organization					
2. Meaning					
METHOD:	Teacher activ. stimulates pupil response throughout the	Teacher seeks pupil response sometime during lesson	Teacher seeks little pupil response during lesson	Teacher tends to ignore or overlook pupil during lesson responses	Teacher actively discourages pupil response during lesson
Teacher Pupil Communication					
EVALUATION:	Teacher provides suff. review for student and rewards	Teacher provides suff. review with some reward	Teacher provides some review with some reward	Teacher review not complete with little reward	No provision for review with little, if any, reward
1. Review					
2. Reinforcement					
Degree of Accomplishment	Strong feeling of accomplishment	Some feeling of accomplishment	Mixed feelings of accomplishment	Some doubt of accomplishment	Some feeling of a lack of accomplishment
Total Reaction to Lesson					

Comment:
Strengths
and
Weaknesses

Prepared for Secondary Education Project
Dwight W. Allen

App. Form by: H.E. Aubertine
Revised: 9/6/63

Item 3 1-4

Appendix II

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	70.1631				
ERROR (WITHIN)	95	827.6270	34.8791	792.7478	94	8.4335
TREATMENT + ERROR (TOTAL)	99	897.7900	20.7579	877.0322	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				84.2843	4	21.0711

$F(4, 94) = 2.499$

$p > .05$

Item 3 3-4

Appendix III

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	65.1509				
ERROR (WITHIN)	95	660.6094	27.1894	833.4199	94	8.8662
TREATMENT + ERROR (TOTAL)	99	925.7603	11.7479	914.0124	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				80.5924	4	20.1481

F(4, 94) = 2.272

p < .05

Item 3 1-2

Appendix IV

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	120.8809				
ERROR (WITHIN)	95	1087.1191	2.7911	1084.3280	94	11.5354
TREATMENT + ERROR (TOTAL)	99	1208.0000	0.4638	1207.5362	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				123.2082	4	30.8021

$F(\ 4,\ 94) = 2.670$

$p < .05$

Item 4 1-4

Appendix V

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	56.2456				
ERROR (WITHIN)	95	937.0645	41.2417	895.8227	94	9.5300
TREATMENT + ERROR (TOTAL)	99	993.3101	56.8223	936.4878	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				40.6651	4	10.1663

$F(4, 94) = 1.067$

$p > .05$

Item 4 3-4

Appendix VI

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	50.1714				
ERROR (WITHIN)	95	974.7388	55.8872	918.8515	94	9.7750
TREATMENT + ERROR (TOTAL)	99	1024.9102	71.9736	952.9366	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				34.0850	4	8.5213

$F(4, 94) = 0.872$

$p > .05$

Item 4 1-2

Appendix VII

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	98.8882				
ERROR (WITHIN)	95	925.5522	59.6096	865.9427	94	9.2122
TREATMENT + ERROR (TOTAL)	99	1024.4404	56.5245	967.9160	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				101.9733	4	25.4933

$F(4, 94) = 2.767$

$p < .05$

Item 8 1-4

Appendix VIII

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	104.5752				
ERROR (WITHIN)	95	920.0649	0.	920.0649	94	9.7879
TREATMENT + ERROR (TOTAL)	99	1024.6401	0.	1024.6401	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				104.5752	4	26.1438

$F(\ 4,\ 94) =\ 2.671$

$p < .05$

Item 8 3-4

Appendix IX

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	95.2134				
ERROR (WITHIN)	95	975.5366	0.	975.5366	94	10.3780
TREATMENT + ERROR (TOTAL)	99	1070.7500	0.	1070.7500	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				95.2134	4	23.8033

$F(\ 4,\ 94) = 2.294$

$p > .05$

Item 8 1-2

Appendix X

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	92.5122				
ERROR (WITHIN)	95	792.0479	0.	792.0479	94	8.4260
TREATMENT + ERROR (TOTAL)	99	884.5601	0.	884.5601	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				92.5122	4	23.1281

F(4, 94) = 2.745

$p < .05$

Total 1-2

Appendix XI

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	10191.8125				
ERROR (WITHIN)	95	107003.1875	4125.9473	102877.2393	94	1094.4387
TREATMENT + ERROR (TOTAL)	99	117195.0000	2982.3148	114212.6846	98	
Difference for testing adjusted treatment means				11335.4453	4	2833.8613

$F(\ 4,\ 94) = 2.589$

$P < .05$

Total 1-4

Appendix XII

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	8829.5000				
ERROR (WITHIN)	95	94567.3125	3499.9461	91067.3662	94	968.8018
TREATMENT + ERROR (TOTAL)	99	103396.8125	2120.5439	101276.2686	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				10208.9023	4	2552.2256

F(4, 94) = 2.634

P< .05

Total 1-4

Appendix XIII

ANALYSIS OF COVARIANCE TABLE

SOURCE	DF	YY	SUM-SQUARES (DUE)	SUM-SQUARES (ABOUT)	DF	MEAN-SQUARE
TREATMENT (BETWEEN)	4	8829.5000				
ERROR (WITHIN)	95	94567.3125	3499.9461	91067.3662	94	968.8018
TREATMENT + ERROR (TOTAL)	99	103396.8125	2120.5439	101276.2686	98	
DIFFERENCE FOR TESTING ADJUSTED TREATMENT MEANS				10206.9023	4	2552.2256

F(4, 94) = 2.634

p < .05